Abstract

A typical communication system consists of a channel code to transmit signals reliably over a noisy channel. In general the channel code is a set of codewords which are used to carry information over the channel. This thesis deals with Elias upper bound on the normalized rate for Euclidean space codes and on codes which are close to the generalized Singleton bound, like Maximum-Distance Separable (MDS) codes, Almost-MDS codes, Near-MDS codes and certain generalizations of these.

The Elias bound for codes designed for Hamming distance, over an alphabet of size q is well known. Piret has obtained a similar Elias upper bound for codes over symmetric PSK signal sets with Euclidean distance under consideration instead of Hamming distance. A signal set is referred to as uniform if the distance distribution is identical from any point of the signal set. In this thesis we obtain the Elias upper bound for codes over uniform signal sets. This extension includes the PSK signal sets which Piret has considered as a subclass. This extended Elias bound is used to study signal sets over two, three and four dimensions which are matched to groups. We show that codes which are matched to dicyclic groups lead to tighter upper bounds than signal sets matched to comparable PSK signal sets, signals matched to binary tetrahedral, binary octahedral and binary icosahedral groups.

The maximum achievable minimum Hamming distance of a code over a finite alphabet set of given length and cardinality is given by the Singleton bound. The codes which meet the Singleton bound are called maximum distance separable codes (MDS). The problem of constructing of MDS codes over given length, cardinality and cardinality of the finite alphabet set is an unsolved problem. There are results which show the non existence of MDS codes for particular lengths of the code, the cardinality of the code and the alphabet size. Therefore we look at codes which are close to Singleton bound. Almost-MDS codes and Near-MDS codes are a family of such codes. We obtain systematic matrix characterization of these codes over finite fields. Further we charac-

terize these code over Z_m, R-modules and finite abelian groups. Based on the systematic matrix characterization of the codes over cyclic groups we obtain non-existence results for Almost-MDS codes and Near-MDS codes over cyclic groups.

The generalized Singleton bound of the code gives the upper bound on the generalized Hamming weights of the code. Generalized Hamming weights of the code are defined based on the minimum cardinality of the support of the subcodes of the code. MDS code achieves the generalized Singleton bound with equality. We obtain systematic matrix characterization of codes over finite fields with a given Hamming weight hierarchy. Further based on the systematic matrix characterization we characterize codes which are close to the generalized Singleton bound. We also characterize codes and their dual based on their distance from the generalized Singleton bound. We study the properties of codes whose duals are also at the same distance from the generalized Singleton bound. The systematic matrix characterization of codes which meet the generalized Greismer bound is also given.